PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Charles J. Moses, et al.	Group Art Unit: 3679
Serial No.: 10/767,587 Confirm 6194	Examiner:
Filed: 01/29/2004	Atty. Dkt. No.: 11666.0138.NPUS00
For: HIGH TEMPERATURE FLEXIBLE PIPE JOINT	

RULE 132 DECLARATION OF MICHAEL E. HOGAN

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

.In response to the Official Action dated April 7, 2006, now comes Michael E. Hogan, who deposes and states:

1. I am a graduate of Texas A&M University and received my Engineering Technology degree in the year of 1977. I am also a graduate of the University of Texas at Arlington and received my BSME degree in the year of 1983. I became a registered Professional Engineer in Texas in the year of 1986 (Reg. No. 60110).

2. I have read and fully understood U.S. patent application Serial No. 10/767,587.

3. I have read and fully understood the Official Action dated April 7, 2006, and the OSI documents cited therein. In particular, I have read and fully understood the following OSI documents submitted as Exhibits A to G in an Information Disclosure Statement filed June 22, 2004:

C50 (Exhibit A) "Joint Industry Program for High Temperature FlexJoints®," Oil States Document No. SP1K-23-040, Rev. A, created 16 July 1996, published Aug. 4, 2005, 17 pages, U.S. Patent Application Ser. 10/767,587, U.S. Patent and Trademark Office, Arlington, Virginia.

C51 (Exhibit B) HOGAN, Michael E., et al., "Joint Industry Program High Temperature FlexJoint® Final Report," Oil States Document No. SP1E-23-090 created Sep. 9, 1998, published Aug. 4, 2005, 11 pages, U.S. Patent Application Ser. 10/767,587, U.S. Patent and Trademark Office, Arlington, Virginia.

C52 (Exhibit C) "Exxon-Erha FlexJoint® Preliminary Design Summary," Oil States Document created June 18, 2001, published Aug. 4, 2005, pages 1-22, U.S. Patent Application Ser. 10/767,587, U.S. Patent and Trademark Office, Arlington, Virginia.

C53 (Exhibit D) "Proposal for the Provision of FlexJoints® for the Esso Exploration and Production Nigeria Ltd Erha Project EPC2," Oil States Document SP1K-23-113, Rev 0, created June 28, 2001, page 2-1 and page 3-9, published Aug. 4, 2005, U.S. Patent Application Ser. 10/767,587, U.S. Patent and Trademark Office, Arlington, Virginia.

C54 (Exhibit E) "Crazyhorse 12-In. Import FlexJoint® Design," Oil States Document created May 10, 2001, published Aug. 4, 2005, pages 1-28, U.S. Patent Application Ser. 10/767,587, U.S. Patent and Trademark Office, Arlington, Virginia.

C55 (Exhibit F) MOSES, Philip S., et al., "12" High Temperature / High Pressure (HTHP) SCR FlexJoint® Design Study for the BP Crazy Horse Project,"

Oil States Document No. SP1E-23-163 created Aug. 31, 2001, pages 65, 67, and Appendix A, published Aug. 4, 2005, U.S. Patent Application Ser. 10/767,587, U.S. Patent and Trademark Office, Arlington, Virginia.

C56 (Exhibit G) "Thermal barrier configuration," Oil States flexible joint summary drawing, Figure 5-53 and Appendix A created Oct. 30 2002, published Aug. 4, 2005, U.S. Patent Application Ser. 10/767,587, U.S. Patent and Trademark Office, Arlington, Virginia.

4. I am one of the named inventors of the subject matter claimed in U.S. patent application Serial No. 10/767,587.

5. I am presently employed by Oil States Industries, Inc. (hereinafter "Oil States"), the assignee of U.S. patent application Serial No. 10/767,587, as Vice President.

6. As an employee of Oil States, I have been working continuously in the field of flexible pipe joints for subsea risers of offshore hydrocarbon production platforms since 1992.

7. The work described in the Oil States documents specifically identified above as references C50 (Exhibit A) to C56 (Exhibit G) was carried out by me and the other named inventors Charles J. Moses, Philip S. Moses, Todd M. Potoroff, and Carl C. Spicer working under my supervision. During the time that this work was performed, all of the named inventors were employed by Oil States Industries, Inc. From the time that this work was performed up to the present time, all of the named inventors have been continuously employed by Oil States in work on flexible pipe joints for conveying production fluid of greater than 180 °F in a subsea environment, more commonly referred to as high temperature flexible pipe joints.

8. As described in Ref. C58, "Oil States Standard FlexJoints®," April 1996, 4 pages, Oil States Industries, Inc., Arlington, TX, since 1976 Oil States Industries has been manufacturing and selling subsea flexible pipe joints including elastomeric flex elements. Before shipment, each Oil States subsea flexible pipe joint design is subjected to an extensive testing program to ensure customer specifications.

9. As described in Angel U.S. Patent 4,273,363, by about 1979 the industry was becoming aware of a need for a subsea flexible pipe joint including an elastomeric flex element and capable of conveying production fluid at a temperature much higher than can be withstood by elastomers commonly used in the flex element. Angel, for example, expresses a need for a subsea flexible pipe joint for conveying crude oil at a temperature of about 230°F, and says that no known elastomer can withstand a temperature of 230 °F for the 20-30 year lifetime desired for the couplings. (Angel, Col. 1, lines 30-41.) Angel proposes to insulate the elastomeric flex element from the production fluid, for example in Angel's FIG. 1 by forming an air space or evacuated chamber (13) in the flared end of the extension pipe in the vicinity of the elastomeric flex joint. However, I am not aware that a flexible pipe joint as shown in FIG. 1 of Angel has ever been used in practice. In practice, it is desired to use an extension pipe in which the flared end is forged for strength and durability, and therefore does not have an internal chamber. Also, the Oil States development work has shown that it is more practical to produce a high temperature flexible pipe joint in which the elastomeric flex element is not only shielded from the high temperature of the production fluid but also configured to better withstand a substantial

temperature gradient across the inner elastomer layers near to the flared end of the extension pipe.

10. By about 1996, Oil States became aware that offshore oil producers needed a flexible pipe joint capable of continuously handling a production flow at 130 °C (266 °F). Oil States thought that this should be done by using a heat shield to keep a conventional elastomeric flex element below a temperature at which the flex element could operate continuously over the service life. At that time Oil States thought that a conventional flex element could be operated up to about 80 °C (176 °F). Oil States planned to develop an analytical technique using heat transfer Finite Element Analysis to estimate temperatures in the flex element and then justify them thorough temperature testing of the flexible pipe joint. This analytical technique would then be used to design high temperature flexible pipe joints with assurance that the flex element would not be exposed to excessive temperatures. Such was the goal of development program described in Ref. C50 (Exhibit A) "Joint Industry Program for High Temperature FlexJoints®," Oil States Document No. SP1K-23-040. The development program was to include: (1) identify test parameters for a flexible pipe joint; (2) test elastomeric compounds and adhesive bond systems; (3) investigate an initial design for temperature resistance; (4) conduct a heat transfer finite element analysis study of the flexible pipe joint design; (5) fabricate, instrument, test and analyze a flexible pipe joint to determine its heat transmission properties. Oil States desired offshore oil producers to participate in this program in order to obtain information about customer requirements and actual service conditions, and to defray the cost of testing. Oil States offered the offshore oil producers the opportunity to gain information on the performance of

elastomer at elevated temperature (at least 80 °C) and to influence additional testing for their further program concerns and requirements.

11. Ref. C50 (Exhibit A) "Joint Industry Program for High Temperature FlexJoints®," Oil States Document No. SP1K-23-040, was presented to Shell Offshore and Statoil A.S. I am not aware that these documents have been published prior to the publication of the present patent application Serial No. 10/767,587 by the Patent and Trademark Office on about Aug. 4, 2005. Only Shell Offshore and Statoil A.S. participated in this Joint Industry Program. They contributed at least $60,000.00 to Oil States to participate in this Joint Industry Program.

12. During the Joint Industry Program, testing of the actual thermal properties of elastomer materials used by Oil States for flexible pipe joints was performed by Holometrix, an independent laboratory. Flexible pipe joint testing was confined to a small-scale (4") high-pressure flexible pipe joint prepared specifically for the Joint Industry Program. The testing of the 4" flexible pipe joint was performed by Det Norske Veritas (DNV) located in Høvik, Norway. The test results of the Joint Industry Program are summarized in Ref. C51 (Exhibit B) HOGAN, Michael E., et al., "Joint Industry Program High Temperature FlexJoint® Final Report," Oil States Document No. SP1E-23-090. The thermal conductivity, specific heat, and diffusivity of three Oil States elastomeric compounds were established for future use. An elastomer to metal bonding system was selected for use at temperatures up to 130 °C (266 F). An Oil States elastomeric compound did not degrade at a temperature of 82 °C (180 °F). Oil

States could manufacture a flex element according to engineering drawing specifications. Teflon provided the greatest temperature reduction at the elastomer for a 130 °C (266 F) condition. A flexible pipe joint could function at 130 °C (266 °F) if a thermal barrier could be designed that would be suitable for flowline service conditions. In short, the JIP study suggested that a flexible pipe joint designed to withstand long-term operation at 130 °C (266 °F) might be feasible.

13. Ref. C51 (Exhibit B) HOGAN, Michael E., et al., "Joint Industry Program High Temperature FlexJoint® Final Report," Oil States Document No. SP1E-23-090, was presented to Shell Offshore and to Statoil A.S. as participants in the program. I am not aware that these documents have been published prior to the publication of the present patent application Serial No. 10/767,587 by the Patent and Trademark Office on about Aug. 4, 2005. As indicated in the "Proprietary Rights Notice" on the cover page of this document, the test results and conclusions were designated proprietary information of Oil States.

14. In early 2001, development of a high temperature flexible pipe joint at Oil States continued with two project-oriented studies for an ExxonMobil Erha Project and a BP Crazy Horse Project (later named Thunder Horse Project). In each case, the offshore oil producer (ExxonMobil and BP) was desirous of obtaining from Oil States a high temperature flexible pipe joint capable of certain service conditions, but both the offshore oil producer and Oil States understood that fabrication and testing of a full-scale prototype under the service conditions in a laboratory environment would be required before any flexible pipe joint should be tested or used in a subsea

environment. At the initiation of these two studies, the conventional Oil States flexible pipe joints were rated for a 180 °F maximum operating temperature, and Oil States did not feel that existing flex joint compounds could endure extended exposure over 200 °F. Oil States proposed designing and configuring a thermal barrier system to limit the flex element rubber temperature below 180 °F. Oil States also proposed to design the flex element with a high modulus rubber compound for the initial inner layer adjacent to the extension pipe to maximize fatigue life by minimizing the shear strain in the layers most affected by the high temperature, and to compensate for modulus softening induced by the elevated temperatures. Major concerns included the flex element elastomer bond, and flex element mechanical, fatigue life, and aging properties. PEEK was proposed as a thermal barrier material, although there were fabrication concerns and questions about whether the PEEK could carry a load and whether a metal cover over the PEEK was necessary.

15. It is customary for suppliers of oil production equipment to enter into design and manufacturing services agreements with oil production companies, under which the oil production companies may issue work orders or releases for services and equipment, including the design and development of novel equipment. For entering into such an agreement, it is customary for a supplier to submit a proposal including a preliminary production schedule and preliminary prices for services and equipment not yet designed or constructed. Under such an agreement, the supplier has an obligation to provide the services and equipment so long as the services and equipment can be provided in accordance with good industry practices. For the

development of novel equipment, this is understood to mean that the supplier has an obligation to provide novel equipment so long as the oil production company submits a purchase order for the novel equipment and the novel equipment can be made to function for its intended purpose in accordance with sound and generally accepted engineering practice. For novel subsea oil production equipment such as flexible pipe joints for offshore production risers, sound and generally accepted engineering practice includes sufficient testing of the equipment prior to use in a subsea environment to ensure a very low likelihood that crude oil will be released into the environment during the service life of the equipment. Such testing should include extreme conditions of temperature, pressure, tensile loading, and angular deflection that are likely to occur under actual service conditions.

16. The ExxonMobil Erha Project began from Ref. C52 (Exhibit C) "Exxon-Erha FlexJoint® Preliminary Design Summary," Oil States Document created June 18, 2001, and the proposal of Ref. C53 (Exhibit D) "Proposal for the Provision of FlexJoints® for the Esso Exploration and Production Nigeria Ltd Erha Project EPC2," Oil States Document SP1K-23-113, Rev 0, created June 28, 2001. As shown on page 2-1 and page 3-9 of this proposal, prices were quoted pursuant to customer requirements (including a maximum design temperature of 115 °C) for engineering design and analysis, tooling, four 12 inch steel centenary riser (SCR) flexible pipe joints, one 12-inch Mock-up, optional weld qualification, four optional flexible pipe joint to riser pipe welds, and four claddings.

17. Ref. C52 (Exhibit C) "Exxon-Erha FlexJoint® Preliminary Design Summary," Oil States Document created June 18, 2001, was shown to Mike Wier and Wan C. Kan of ExxonMobil. No copies of this presentation were distributed. I am not aware that these documents have been published prior to the publication of the present patent application Serial No. 10/767,587 by the Patent and Trademark Office on about Aug. 4, 2005.

18. Ref. C53 (Exhibit D) "Proposal for the Provision of FlexJoints® for the Esso Exploration and Production Nigeria Ltd Erha Project EPC2," Oil States Document SP1K-23-113, Rev 0, created June 28, 2001, was shown to ExxonMobil and a copy was given to Stolt Offshore AS, an ExxonMobil contractor. I am not aware that these documents have been published prior to the publication of the present patent application Serial No. 10/767,587 by the Patent and Trademark Office on about Aug. 4, 2005.

19. In response to the Erha proposals, ExxonMobil Global Services Company retained Oil States in a consulting services agreement effective from June 20, 2001 to June 19, 2002, for providing thermal analysis, design and consulting services to be defined in work orders issued by ExxonMobil Global Services Company or its affiliates. Oil States was obligated to ascertain whether any drawings and specifications applicable to the equipment and services of any purchase order were at variance with law or good industry practices and to ensure that any necessary changes were made before proceeding with the provision of the equipment and services. Oil States was obligated to keep confidential the secret business and technical

information provided by ExxonMobil Global Services Company and its affiliates or developed or acquired by Oil States in performing services under the purchase orders except technology relating to the Oil States' high-temperature flexible pipe joint invention. It was Oil State's right and responsibility to mark any drawings and descriptions disclosing this technology as being confidential prior to including them in any transmittals to ExxonMobil Global Services Company or its affiliates. A coordination plan was developed between ExxonMobil and their subcontractor Stolt Offshore AS whereby all technical and sensitive information would be discussed between ExxonMobil and Oil States exclusively under the confidentiality status. Requests by ExxonMobil subcontractors for any technical and process information regarding FlexJoint® design, manufacture, or testing were to be made with a designated contact at the EMDC group of ExxonMobil. The establishment of and compliance with this coordination plan is shown in the copies of my E-mail being submitted to the U.S. Patent and Trademark Office together with this declaration.

20. Pursuant to the consulting services agreement with ExxonMobil Global Services Company, Oil States received a work order for a high temperature flexible pipe joint study including determination of fatigue performance of standard nitrile elastomer for compensation not to exceed $45,000. Oil states was requested to: (1) prepare a written review of relevant high temperature flexible pipe joint studies to date, documenting the basis and calibration of computer based analysis; (2) perform a preliminary thermal barrier design and analyze using 220 °F flowline temperature for a 12-inch flexible pipe joint according to Erha requirements, analyze to

minimum flowline temperatures (40 °F) to determine thermal response of the flexible pipe joint to this condition, and identify critical details for further design and key manufacturability concerns; (3) perform practical, detailed design of a flexible pipe joint incorporating known manufacturing techniques, process optimize heat barrier placement, followed by detailed thermal analysis, and perform fatigue assessment based upon appropriate test results; (4) perform flexible pipe joint elastomer flow-through fatigue testing at flowline temperatures of 190 °F and 220 °F; (5) provide a monthly progress report commencing July 1, 2001; and (6) complete the study and submit the result to ExxonMobil by Sept. 1, 2001. In response to this work order, Oil States conducted tests of various elastomers for aged strength, peel adhesion, and shear strain for immersion and flow-through under elevated temperatures, as described in an Oil States' proprietary document SP1E-23-181, entitled "Elastomer Development for HPHT SCR FlexJoint® Applications," submitted to ExxonMobil on June 17, 2002. Oil States further conducted a FlexJoint® thermal analysis and structural analysis, a thermal barrier analysis, and a fatigue analysis on an ExxonMobil Erha 12" FlexJoint® design, as described in an Oil States' proprietary document SP1E-23-161, entitled "Erha FlexJoint® Design Study," submitted to ExxonMobil on March 19, 2003. The study for ExxonMobil continued until March 2002. ExxonMobil paid Oil States about $45,000 for this study. No production riser flexible pipe joints were produced during this project. However, in about August of 2002, ExxonMobil approved funding for a 25% interest in the development of the BP Thunder Horse project. Thus, ExxonMobil became an affiliate of BP with respect to the Oil Sates' development of the high-temperature flexible pipe joint for the BP Thunder Horse project

21. The BP Thunder Horse project began in 2001 in parallel with the ExxonMobil Erha project. (See Ref C54 (Exhibit E) "Crazyhorse 12-In. Import FlexJoint® Design," Oil States Document created May 10, 2001, pages 1-28, and Ref. C55 (Exhibit F) MOSES, Philip S., et al., "12" High Temperature / High Pressure (HTHP) SCR FlexJoint® Design Study for the BP Crazy Horse Project," Oil States Document No. SP1E-23-163 created Aug. 31, 2001, pages 65, 67, and Appendix A.) An objective of this project was to produce four 12" high-temperature, high-pressure (HTHP) production riser SCR flexible pipe joints, and preliminary prices and scheduling were quoted for these four flexible pipe joints.

22. Ref C54 (Exhibit E) "Crazyhorse 12-In. Import FlexJoint® Design," Oil States Document created May 10, 2001, pages 1-28, was shown to BP. No copies of this presentation were distributed. I am not aware that these documents have been published prior to the publication of the present patent application Serial No. 10/767,587 by the Patent and Trademark Office on about Aug. 4, 2005.

23. Ref. C55 (Exhibit F) MOSES, Philip S., et al., "12" High Temperature / High Pressure (HTHP) SCR FlexJoint® Design Study for the BP Crazy Horse Project," Oil States Document No. SP1E-23-163 created Aug. 31, 2001, pages 65, 67, and Appendix A, were shown to BP and a copy was given to Harvey Mohr of Aker Engineering, who acted as a technology consultant to BP for the Crazy Horse project. I am not aware that these documents have been published prior

to the publication of the present patent application Serial No. 10/767,587 by the Patent and Trademark Office on about Aug. 4, 2005.

24. In response to the Oil States proposal of Ref. C55 (Exhibit F), on about April 9, 2002, BP retained Oil States in a design and manufacturing services agreement for providing flexible pipe joint systems design, manufacturing services, finished goods assembly, and testing services, including validation and testing of new technologies for use in the final design, to be specified in work releases issued by BP. A copy of this agreement, designated as Contract BPA-01-05771 Rev. 1, is being submitted to the U.S. Patent and Trademark Office together with this declaration. Oil States warranted that materials and equipment provided by Oil States would be suitable for their intended purpose. Where there were no applicable specifications covering the work, then the work was to be performed in accordance with the highest level of accepted standards within the industry. Oil States was obligated to treat as confidential and proprietary all work product and BP's secret background data, although Oil States would own each invention that would be made by Oil States as a direct result of the work. Upon provisional acceptance of the work, all items provided by Oil States under the agreement for the work became property of BP. BP reserved the right of observation and inspection to secure satisfactory completion of the work, including access to Oil States' facility during working hours for inspection of the work. Due to BP's financial investment in the development, a representative of BP was onsite at Oil States to monitor the quality of the process and witness the testing procedures. Oil States was also obligated to prepare periodic progress presentations to BP and made periodic progress

presentations to BP. Work began in response to a Release No. BPR-02-06528 executed April 9, 2002, a copy of which is being submitted to the U.S. Patent and Trademark Office together with this declaration.

25. During the Thunder Horse project, by October 2002, an engineering design phase of a 12" high-temperature high-pressure (HTHP) flexible pipe joint had been carried out, and the design had been submitted to BP for review. This design phase included a review of all specifications and development of design methodology; a preliminary analysis of the HTHP flexible pipe joint design for conformance to envelope requirements; a review of preliminary analyses and examination of possible modifications for improvement; elastomer selection; complete structural, thermal, and fatigue analyses of the design; and review of the final design. The maximum design temperature was 235 °F. The selected elastomer was a nitrile compound with a modified cure system. The elastomer layers, steel reinforcements, and elastomer cover in the design were evaluated using finite element analyses. Compenol water-glycol solution was selected for the fluid to fill the internal cavity about the bellows. The internal cavity was to be sealed from the production fluid by metal-to-metal seals at the top and bottom of the bellows. A 30% glass fiber filled polyetheretherketone (PEEK) thermoplastic was selected to be the thermal barrier material. An Inconel metal cover was to be welded to the extension over the PEEK material. The thermal barrier configuration selected at that time consisted of a set of five PEEK rings that mated together inside the upper section of the extension. (See Exhibit G, thermal barrier configuration Figure 5-53, and Appendix A flexible joint summary drawing dated 30 October 2002.) The first

four PEEK rings were to be full circumference rings with mating profiles matched-machined and bonded to the upper section of the extension. The fifth and final ring was to be divided into five individual segments that interlock as they are installed between the top face of the previously installed lower PEEK rings and an Inconel metal ring welded to the top of the extension. Two PEEK shear pins were to be inserted into pre-drilled holes in the last segment to secure it in place to the full circumference ring below it. Araldite 2014 high-temperature epoxy was selected to bond the PEEK rings in place.

26. During the BP Thunder Horse project, to refine the details of the HTHP flexible pipe joint design, structural and thermal finite element analysis (FEA) using two-dimensional and three-dimensional models was continued until at least 31 January 2003. The thermal analysis included computational fluid dynamic analysis (CFD) using three-dimensional models of the flexible pipe joint with its high temperature hardware. The hardware configuration was approved on 10 February 2003 for fabrication of a full-scale prototype of a 12" high-temperature flexible pipe joint.

27. The BP Thunder Horse project included fabrication of the full-scale prototype of the 12" high-temperature flexible pipe joint. This was the first time in Oil State's development that a polymeric heat barrier, high temperature flex element configuration, and metallic bellows with barrier seal and high temperature stable, incompressible annulus fluid were brought together in a single unit to combat the thermal degradation of the molded laminated bearing in a high

temperature flexible pipe joint. Final fabrication was completed about 30 April 2003, and initial testing of the full-scale prototype began at Oil States on 2 May 2003. Due to the results of our computational analysis and the successful fabrication of the full-scale prototype, we submitted to Stolt Offshore AS an Oil States Document SP1K-23-114(B) Commercial, Rev. 2 created 30 June 2003, and an Oil States Document SP1K-23-114(B) Technical, Rev. 2, created 20 June 2003. Copies of these documents are being submitted to the U.S. Patent and Trademark Office together with this declaration. However, our testing of the full-scale prototype was terminated due to technical problems with the elastomer composition and bonding system causing premature failure of the inner elastomer layers, but at the time testing was terminated, the temperatures at the critical areas in the flex element had stayed within the acceptable range indicating that the temperature control enhancements had functioned as designed. Our first full-scale prototype experienced premature failure of the inner elastomer layers of the flex element and testing was terminated after 13,734 load cycles of alternating 6 degree angular rotation. Our second full-scale prototype also experienced premature failure of the inner elastomer layers of the flex element and testing was terminated after 1776 load cycles of alternating 6 degree deflection angle rotation. In each case the internal pressure was 7,500 psi, the axial tension was 800 kips, and the flex element had 22 elastomeric layers each having a thickness of 0.27 inches.

28. From my experience, I understand that it is not possible to predict, with a high level of confidence, the performance of elastomeric flex elements under conditions of temperature, pressure, temperature loading, and deflection beyond the limits already proven by testing of a

full-scale prototype under the actual conditions. In practice a high level of confidence that the elastomeric flex element will not fail is required so that the hydrocarbon production fluid will not be released into the subsea environment.

29. At the time of filing the present application Ser. No. 10/767,587, testing upon the full-scale prototypes was continuing in an attempt to avoid the premature failure of the inner elastomer layers. At that time we had a relatively good understanding of temperature-induced softening of the modulus of the inner elastomer layers due to a temperature gradient, but a relatively poor understanding of precisely when an elastomeric material strain capacity constraint would occur due to the combination of production fluid pressure, riser tension, and maximum extension pipe deflection angle. We thought that there was an advantage for the inner elastomer layers to be thicker than the outer elastomer layers because thicker inner elastomer layers act as a heat shield for the outer elastomer layers due to the relatively low heat conductivity of the elastomer, and thicker inner elastomer layers may also reduce the direct shear strain on the elastomer. (See paragraph [00046] of our specification.) However, we also thought that there would be some situations where it would be desirable to make the inner elastomer layers thinner than the outer elastomer layers, for example when there would be an elastomeric material strain capacity constraint due to the combination of production fluid pressure, riser tension, and maximum extension pipe deflection angle, that would require thin inner elastomer layers to prevent rupturing of the inner elastomer layers at the extreme inner or outer edges of these layers,

especially at the extreme inner elastomer edges of these inner elastomer layers at the elastomer-seawater interface. (See paragraph [00052] of our specification.)

30. In a third full-scale prototype, in order to improve the resolution of the fatigue response, we reduced the alternating deflection angle slightly (from 6 degrees to from 4 to 6 degrees), we reduced the temperature of the innermost elastomer layer slightly (from 180 °F to 175 °F), and we reduced the axial tension from 800 to 500 kips, and we reduced the thickness of the innermost elastomer layers from 0.27 inches to 0.14 inches with the goal of reducing compression-induced strain. This prevented premature failure of the inner elastomer layers, so that about 97,0000 load cycles were required to cause a 25% change in rotational stiffness. Thus, after the filing of our application Ser. No. 10/767,587, we learned that under the conditions of the first and second tests upon the full-scale prototypes, there was an elastomeric material strain capacity constraint dictating that the innermost elastomer layers should be thinner than the outermost elastomer layers. To ensure compliance with this elastomeric material strain capacity constraint, our current validation program for a high temperature flexible pipe joint design is based on determining the frequency of extreme pressure, temperature, tension, and deflection events that may occur occasionally but not frequently in the subsea environment during the desired service life of at least twenty years, and subjecting the high temperature flexible pipe joint design during testing to the extreme conditions that may occur. BP paid Oil States US$ 1,960,300 for the prototype testing. However, because two additional trials were required in

order to arrive at the correct design features, Oil States subsequently invested more than US$ 750,000 additional from its funds for this development.

31. The success of the BP Thunder Horse prototype testing project on the third trial resulted in an order dated May 5, 2004 from BP to Oil States for the fabrication and delivery of five production units of our high-temperature flexible pipe joints. A copy of this order, designated as Release No. BPR-04-00927, is being submitted to the U.S. Patent and Trademark Office together with this declaration. The five production units included two 12" HPHT SCR flexible pipe joints, two 10" HPHT SCR flexible pipe joints, and one 8" HPHT SCR flexible pipe joint. Pursuant to this order, Oil States fabricated the five production units, each of which included an elastomeric flex element having alternating elastomer layers and metal reinforcement layers in which the inner elastomer layers had a higher shear modulus than the outer elastomer layers to shift strain from the inner elastomer layers to the outer elastomer layers. Each of the five production units also included Iconel cladding of the internal diameter of the extension pipe in the vicinity of the elastomeric flex element, and a fiberglass reinforced PEEK thermal barrier inserted into the extension pipe. Pursuant to this order, from November 2004 to January of 2005, Oil States delivered the five production units to RTI Energy Systems of Spring, Texas, for integration of the production units into subsea production risers for the Thunder Horse facility located in the Gulf of Mexico approximately 150 miles southeast of New Orleans. The order also included some additional computational analysis of the design of theses production high-temperature flexible pipe joints. BP paid Oil States at least $3,237,600 for filling this order.

32. In view of the above, I conclude that prior to January 29, 2003, testing had not yet demonstrated that a flexible pipe joint of the kind having an elastomeric flex element of alternate elastomer layers and metal reinforcement layers was actually fit for conveying production fluid greater than 180 °F in a subsea environment. I further conclude that our proposals and provision of services and flexible pipe joint prototypes to the oil production companies during the Erha and Thunder Horse projects were primarily for the purpose of experimentation to perfect our invention and necessary for making our high temperature flexible pipe joint fit for actual use in a subsea environment.

33. I HEREBY DECLARE THAT ALL STATEMENTS MADE OF MY OWN KNOWLEDGE ARE TRUE AND THAT ALL STATEMENTS MADE ON INFORMATION AND BELIEF ARE BELIEVED TO BE TRUE; AND FURTHER THAT THESE STATEMENTS WERE MADE WITH THE KNOWLEDGE THAT WILLFUL FALSE STATEMENTS AND THE LIKE SO MADE ARE PUNISHABLE BY FINE OR IMPRISONMENT, OR BOTH, UNDER SECTION 1001 OF TITLE 18 OF THE UNITED STATES CODE AND THAT SUCH WILLFUL FALSE STATEMENTS MAY JEOPARDIZE THE VALIDITY OF THE APPLICATION OR ANY PATENT ISSUED THEREON.

Respectfully submitted,

Michael E. Hogan

Michael E. Hogan

6 October 2006

date